Amendment Under Art. 11

4. Items to be Amended

Specification and Scope of Claims

5. Contents of Amendments

(1) In lines 3 through 5 of page 11 of the Specification, "flow in a parallel direction through the static mixer 2 to be made fine and be in gas-liquid contact by the mixture and agitation function" is amended as "flow in a parallel direction through the static mixer 2. As a result, gas (FG) and liquid (FL) are made fine and in gas-liquid contact by the mixture and agitation function".

(2) In lines 7 through 9 of the same page, "The above gas-liquid mixture and agitation operation are executed without power and with high efficiency. Hence, energy can be saved." is amended as "Since the above gas-liquid mixture and agitation operation are executed without power and with high efficiency, energy can be saved.".

(3) In line 11 of the same page, "Similarly, FIG. 2" is amended as "FIG. 2".

(4) In line 9 of page 12 of same, "Similarly, FIG. 3" is amended as "FIG. 3".

(5) In lines 6 through 7 of page 13, "Further, a passage tube 16 with a wide bore (500mm or more in diameter) can be used" is amended as "Further, a passage tube 16 with a wide bore (500mm

or more in diameter) can be used when providing a plurality of gas blowout portions 20".

(6) In line 13 of the same page, "[Embodiment 4]" is deleted.

(7) In lines 14 through 15 of the same page, "FIGS. 4A and 4B show an embodiment of a static mixer used in the present invention" is amended as "FIGS. 4A and 4B show an example of static mixers 2, 9, 13 and 17 used in the first to third embodiments of the present invention".

(8) In line 17 of the same page, "similarly, FIG. 4B" is amended as "FIG. 4B".

(9) In line 24 of the same page through line 1 of page 14 of same, "In FIG. 4B, similarly three left twisted blades 31 are provided in a static mixer 30 disposed in a cylindrical passage tube 29." is amended to be started as a new paragraph.

(10) In line 10 of page 14, "and" (hiragana characters in Japanese) is amended as "and" (kanji and hiragana characters in Japanese).

(11) In line 20 of the same page, "(spiral angle)" is amended as "(turning angle)".

(12) In line 5 of page 15, the description of "[Embodiment 5]" is deleted.

(13) In lines 6 through 7 of the same page, "FIG. 5 is a basic constitutional diagram showing an embodiment of a static mixer used in the present invention." is amended as "FIG. 5 is a diagram showing another example of static mixers 2, 9, 13 and 17

used in the first to third embodiments of the present invention.".

(14) In line 8 of the same page, "In FIG. 5" is amended as "In the static mixer shown in FIG. 5".

(15) In line 1 of page 16, the description of "[Embodiment 6]" is deleted.

(16) In lines 3 through 4 of the same page, "according to the first embodiment of the present invention" is amended as "according to the first embodiment of the present invention (refer to FIG. 1)".

(17) In line 6 of page 17, the description of "[Embodiment 7]" is deleted.

(18) In line 9 of the same page, "Similarly to FIG. 6" is amended as "Similarly to the first embodiment shown in FIG. 6".

(19) In line 12 of page 19, the description of "[Embodiment 8]" is deleted.

(20) In line 2 of page 21, "[Embodiment 9]" is deleted and "[Application Example 1]" is added.

(21) In line 3 of the same page, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(22) In line 5 of page 22, "$m^3/m^2\cdot$hour" is amended as "$Nm^3/(m^2\cdot$hour)".

(23) In line 6 of the same page, "$m^3/m^2\cdot$hour" is amended as "$Nm^3/(m^2\cdot$hour)".

(24) In lines 8 through 11 of the same page, after the description of "Furthermore, the blowoff pressure of the blower 83 may be the sum of the underwater pressure and the pressure loss of the pneumatic dispatch line 84", the sentence of "Hereupon, symbol N denotes a normal state of the volume (m^3) at a pressure equal to or less than 1 atm at 0 degree centigrade" is added.

(25) In line 20 of the same page, "$Nm^3/m^2 \cdot Hr$" is amended as "$Nm^3/(m^2 \cdot hour)$".

(26) In line 21 of the same page, "$Nm^3/m^2 \cdot Hr$" is amended as "$Nm^3/(m^2 \cdot hour)$".

(27) In line 4 of page 23, "[Embodiment 10]" is deleted and "[Application Example 2]" is added.

(28) In line 5 of the same page, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(29) In lines 8 through 9 of the same page, "As is similar to the embodiment of the above described FIG. 12" is amended as "Similarly to the example shown in FIG. 12".

(30) In line 17 of page 24, "$m^3/m^2 \cdot hour$" is amended as "$Nm^3/(m^2 \cdot hour)$".

(31) In line 18 of the same page, "$m^3/m^2 \cdot hour$" is amended as "$Nm^3/(m^2 \cdot hour)$".

(32) In line 19 of the same page, "[Embodiment 11]" is deleted and "[Application Example 3]" is added.

(33) In line 6 of page 26, "[Embodiment 12]" is deleted and "[Application Example 4]" is added.

(34) In line 7 of the same page, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(35) In line 23 of page 28, "$m^3/m^2 \cdot$hour" is amended as "$Nm^3/m^2 \cdot$hour".

(36) In line 6 of page 30, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(37) In line 10 through 11 of the same page, "when similarly applied to" is amended as "when the diffused gas aeration apparatus according to the present invention is applied to".

(38) In line 10 of the same page, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(39) In line 12 through 13 of the same page, "when similarly applied to" is amended as "when the diffused gas aeration apparatus according to the present invention is applied to".

(40) In line 12 of the same page, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(41) In line 14 through 15 of the same page, "when similarly applied to" is amended as "when the diffused gas aeration apparatus according to the present invention is applied to".

(42) In line 14 of the same page, "a block diagram showing an embodiment" is amended as "a diagram showing an example".

(43) In lines 16 through 19 of claim 2 on page 32, "a cylindrical passage tube substantially disposed vertically in

which fluid passes in the longitudinal direction and in which a static mixer is provided" is amended as "a cylindrical passage tube substantially disposed vertically in which fluid passes in the longitudinal direction and in which a first static mixer is provided".

(44) In line 22 of the same claim on the same page, "in which a static mixer is provided" is amended as "in which a second static mixer is provided".

(45) In line 6 of claim 8 on page 34, "(spiral angle)" is amended as "(turning angle)".

(46) In line 14 of claim 9 on the same page, "$m^3 \cdot$hour" is amended as "$Nm^3 \cdot /(m^2 \cdot$hour)".

(47) In line 21 of claim 10 on the same page, "$m^3 \cdot$hour" is amended as "$Nm^3 \cdot /(m^2 \cdot$hour)".

(48) In line 2 of claim 11 on page 35, "$m^3/m^2 \cdot$hour" is amended as "$Nm^3 \cdot /(m^2 \cdot$hour)".

6. List of Attached Documents

(1) Page 11 and page 11/1, page 12, page 13 and page 13/1, page 14, page 15, page 16 and page 17, page 19, page 21, page 22, page 22/1, page 23, page 24, page 26, page 28, and page 30 and page 30/1 of the Specification

(2) Page 32 and page 32/1, page 34, and page 35 of the claims

Page 11 and page 11/1, page 12, page 13 and page 13/1, page 14, page 15, page 16, page 17, page 19, page 21, page 22 and page 22/1, page 23, page 24, page 26, page 28, and page 30 and page 30/1 of the Specification

generates air-lift effect, whereby gas (FG) which rises involving liquid (FL) introduced from the lower part of the passage tube 1 and the liquid (FL) flow in a parallel direction through the static mixer 2. As a result, gas (FG) and liquid (FL) are made fine and in gas-liquid contact by the mixture and agitation function and then are discharged into liquid, where aeration, diffusion or chemical reaction is executed. Since the above gas-liquid mixture and agitation operation are executed without power and with high efficiency, energy can be saved.

[Embodiment 2]

FIG. 2 is a pattern diagram showing a second embodiment of the present invention. In a cylindrical passage tube 8 substantially disposed vertically in which fluid passes in the longitudinal direction, a set of static mixer 9 is provided and a gas blowoff portion 12 that supplies gas (FG) through a pneumatic dispatch line 11 is disposed in a space portion 10 below the static mixer 9. In the gas blowoff portion 12 is provided a static mixer 13. Further, below the static mixer is disposed a liquid-introducing portion 14 which introduces liquid (FL). In a diffused gas aeration apparatus 15 thus constructed, gas (FG) is gushed and supplied from the static mixer 13

provided in the gas blowoff portion 12 on the lower end of the static mixer 9 in the passage tube 8 through the space portion 10. Liquid (FL) is introduced from the liquid-introducing portion 14 on the lower end side of the passage tube

8 into the space portion 10 by means of air-lift effect generated by the ascending force of the gushing gas (FG). Gas (FG) which has been made fine and accompanying liquid (FL) flow upward in a parallel direction through the static mixer 9 to be in gas-liquid contact and then to be discharged into liquid. Thus, aeration, diffusion and chemical reaction progress with liquid and gas in gas-liquid contact sufficiently.

[Embodiment 3]

FIG. 3 is a pattern diagram showing a third embodiment according to the present invention. In a cylindrical passage tube 16 in which fluid passes and a set of static mixer 17 is provided, and a plurality of gas blowoff portions 20 which supply gas (FG) through a pneumatic dispatch line 19 are disposed in a space portion 18 below the static mixer 17. The pneumatic dispatch line 19 is provided from top to bottom through an opening in the longitudinal direction of the static mixer 17.

In a diffused gas aeration apparatus 21 thus constructed, by gushing and supplying gas (FG) from under the static mixer 17 in the upward direction from the gas blowoff portions 20 through the pneumatic dispatch line 19, liquid (FL) introduced from a liquid-introducing portion 22 on the lower end side of the passage tube 16 and rising gas flow in a parallel direction through the static mixer 17, so that gas-liquid contact proceeds in the same manner as described above.

In addition, by providing the gas blowoff portions 20 with static mixers to be used similarly to the second embodiment of the present invention, gas-liquid contact efficiency will further be improved. The number of gas blowoff portions 20 can be flexibly decided, depending upon the purpose.

Further, a passage tube 16 with a wide bore (500mm or more in diameter) can be used when providing a plurality of gas blowoff portions 20, which enables gas-supplying ability per passage tube to improve a great deal, so that processing time can be shortened. Further, since the number of pneumatic dispatch lines arranged decreases, piping work costs and maintenance costs are also reduced to be low. Further, the enlargement of an apparatus can be facilitated.

FIGS. 4A and 4B show an example of static mixers 2, 9, 13 and 17 used in the first to third embodiments of the present invention; FIG. 4A is a schematic perspective view of a passage tube with right twisted spiral blades, and FIG. 4B is a schematic perspective view of a passage tube with left twisted blades. In FIG. 4A, three right twisted blades 25 are provided in a static mixer 24 disposed in a cylindrical passage tube 23. The blades 25 are formed of perforated boards with a number of holes 26. Further, there are provided three fluid passages 27, and the fluid passages 27 are continuously joined to each other in the whole longitudinal direction of the blades 25 through an opening 28.

In FIG. 4B, three left twisted blade bodies 31 are provided in a static

mixer 30 disposed in a cylindrical passage tube 29. The blades 31 are formed of perforated boards with a number of holes 32. Further, there are three fluid passages 33 are provided, and the fluid passages 33 are continuously joined to each other in the whole longitudinal direction of the blades 31 through an opening 34. In the passage tubes 23 and 29 in which the static mixer 24 and 30 are disposed, respectively constructed as shown in FIGS. 4A and 4B, while flowing through right twisted or left twisted spiral blades, gas (FG) and liquid (FL) are made to be in gas-liquid contact by continuously repeating the turning in the rightward or leftward direction and dividing, joining, turning over, and shearing stress reaction; and then are discharged into liquid.

In addition, preferably the diameter of the holes (26 and 32) provided in the blades 25 and 31 is in the range of 5 to 30mm, and preferably the aperture ratio of the holes (26 and 32) is in the range of 5 to 80%. Further, preferably the rising rate of gas in the passage tubes (23 and 29) is in the range of 0.1 to 10m/s, more preferably 0.5 and 5m/s. Furthermore, preferably the twisted angle (turning angle) of the blades 25 and 31 is 90°, 180° or 270°; however, 15°, 30°, 45°, 60° or the like can also be used. In the case where a passage tube with a wide bore (500mm or more in diameter) is made, it is possible to make blades (25 and 31) of small twist angles such as 15° and 30°, and to connect three blades with the arrangement of 30° + 30° +

30° = 90°, for example. By doing so, production and processing can be made easy, and the cost of production becomes low. It should be noted that it is possible to accordingly select an arrangement of blades of different twist angles.

FIG. 5 is a diagram showing another example of static mixers 2, 9, 13 and 17 used in the first to third embodiments of the present invention.

In the static mixer shown in FIG. 5, right twisted and left twisted spiral blades 36 and 37 having a plurality of fluid passages are provided in a cylindrical passage tube 35 with a cylindrical space portion 38 in between. Further, a cylindrical space portion 39 is formed below the left twisted blade 37. Note that the arrangement of the right twisted and left twisted blades 36 and 37 in the passage tube 35 is not limited to this basic constitutional diagram, and the blades 36 and 37 can be arranged accordingly, for example, as follows: right + left + right; right + left + right + left; etc. In the passage tube 35 thus constructed, while flowing upward in a parallel direction from the lower part of the passage tube 35 through the space portion 39, through the left twisted blade 37, the space portion 38 and the right twisted blade 36, gas (FG) and liquid (FL) are made in gas-liquid contact by continuously repeating the turning and dividing in the leftward and rightward directions, joining, turning over and shearing stress effect, and then are discharged into liquid.

FIG. 6 is a schematic diagram of a diffused gas aeration apparatus according to the first embodiment of the present invention (refer to FIG. 1). A diffused gas aeration apparatus 40 includes a cylindrical passage tube 43 in which a static mixer 41 is provided and a space portion 42 is provided below the static mixer 41, and two supporting boards 46 in which a gas blowoff portion 44 is provided to be connected to a pneumatic dispatch tube 45 which supplies gas. The pneumatic dispatch tube 45 has the gas blowoff portion 44 provided with a spray nozzle that gushes gas in the vertical direction, and the side opposite to the side where gas enters is closed. The diffused gas aeration apparatus 40 thus constructed is disposed in liquid, and with respect to gas (FG), pressurized gas (FG) is supplied from the gas blowoff portion 44 to the inside of the space portion 42 of the passage tube 43 through the pneumatic dispatch tube 45 by means of a blower, compressor or the like. The gas (FG) involving liquid (FL) from a liquid-introducing portion 47 on the lower end of the passage tube 43 and making the liquid (FL) accompany the gas (FG) by means of air-lift effect generated by the ascending force of the gas (FG) supplied, the gas (FG) and the liquid (FL) flow in a parallel direction through the static mixer 41 to be in gas-liquid contact, and then are discharged into liquid, where aeration, diffusion and reaction treatment are performed. Using the spray nozzle for the gas blowoff

portion 44, gas (FG) is dispersed in liquid (FL) efficiently, thereby improving gas-liquid contact efficiency. It is preferable that this spray nozzle 48 be the one shown in FIG. 7, which is a conical, multilayered structure capable of being in a blowoff state.

FIG. 8 is a schematic diagram of a diffused gas aeration apparatus according to the second embodiment of the present invention. Similarly to the first embodiment shown in FIG. 6, a diffused gas aeration apparatus 49 includes a cylindrical passage tube 50 which has at its lower part a space portion 52 and a liquid-introducing portion 53, a cylindrical pneumatic dispatch tube 55 which has a static mixer 51 and a gas blowoff portion 54, and two supporting boards 56 which support the passage tube 50 and the pneumatic dispatch tube 55. At the gas blowoff portion 54 is disposed a static mixer 57 formed of a plurality of right twisted spiral blades. Gas-liquid contact effect between gas (FG) and liquid (FL) is omitted on the grounds that it is similar to the above-described FIG. 6; since the static mixer 57 has been disposed at the gas blowoff portion 54 of the pneumatic dispatch tube 55, gas (FG) flows upward together with liquid (FL) in the space portion 52 of the passage tube 50 made to be fine by means of the occurrence of turbulence. The gas (FG) which has been made into fine structure and the liquid (FL) flow through the static mixer 51 to be in gas-liquid contact highly efficiently, and

is made into fine structure. Utilizing the gas (FG) of the fine structure, gas-liquid contact efficiency further improves. It should be noted that the twist direction of the blades 66, the twist angle thereof, the combination of the twist direction and angle thereof, the diameter of the holes thereof, and the aperture ratio of the holes thereof can be selected accordingly from a variety of examples. Further, it is preferable that the gas blowoff portion 65 be positioned at the distance of 0.2 to 3 times the diameter of the passage tube away from the lower end side of the static mixer provided in the above described passage tube 59.

FIG. 11 is a schematic sectional view of a diffused gas aeration apparatus according to the third embodiment of the present invention. With respect to a diffused gas aeration apparatus 70, two or more 90° right twisted blades 72 are provided in a cylindrical passage tube 71 in which fluid passes to form a static mixer 73; a cylindrical pneumatic dispatch tube 75 which supplies gas is disposed through an opening 74 in the static mixer 73; two gas blowoff portions 76 are disposed; and static mixers 77 are provided in the gas blowoff portions 76. The blades 72 are formed of perforated boards with a number of holes 78. In the diffused gas aeration apparatus 70 thus constructed, gas (FG) pressurized by gas-supplying means such as a blower, compressor, gas cylinder (not shown in the figure),

parts (dead spaces) of fluid do not arise.

[Application Example 1]

FIG. 12 is a diagram showing an example when a diffused gas aeration apparatus according to the present invention is applied to aeration processing of an activated sludge method.

A diffused gas aeration apparatus 81 is disposed at the bottom of an aeration tank 82 storing raw water, and includes a blower 83 and a pneumatic dispatch line 84 supplying air to the lower part of this diffused gas aeration apparatus 81, a raw water supplying line 85 supplying raw water, and a processed water discharging line 86 discharging processed water. Further, it is preferable that a liquid-introducing portion of the diffused gas aeration apparatus 81 be positioned at the distance of 50 to 200mm away from the bottom of the aeration tank 82. In the diffused gas aeration apparatus 81 thus constructed, by means of air-lift effect generated by the ascending force of air supplied from the lower part of the diffused gas aeration apparatus 81 through the blower 83 and the pneumatic dispatch line 84, while flowing in a parallel direction through the diffused gas aeration apparatus 81, raw water and air are mixed and agitated, with oxygen in the air dissolved in the raw water and the raw water cleaned the number of times intended or repeatedly by aerobic microbes, and then are discharged from the processed water discharging line 86.

Additionally, preferably the supply rate of the amount of air which flows from the lower side to the upper side inside the diffused gas aeration apparatus 81 is, when the depth of water inside the aeration tank 82 is 2 to 6m, in the range of 1800 to 21000 $Nm^3/(m^2 \cdot hour)$, and more preferably in the range of 3600 to 12000 $Nm^3/(m^2 \cdot hour)$. Further, when a diffused gas aeration apparatus 81 with a diameter of 150mm is used, the area for aeration and agitation per piece of apparatus is 3 to $8m^2$. Furthermore, the blowoff pressure of the blower 83 may be the sum of the underwater pressure and the pressure loss of the pneumatic dispatch line 84. Hereupon, symbol N denotes a normal state of the volume (m^3) at a pressure equal to or less than 1 atm at 0 degree centigrade.

When comparing air-flow resistance of a conventional panel diffuser method to that of the method according to the present invention, the resistance by the method of the present invention is 1/5 to 3/5. Further, the compared results of performance of conventional methods A, B, and C in which static mixers provided inside diffuser pipes are used, with the method by the present invention is shown in Table 1. As shown in Table 1, according to the method of the present invention, the air-supplying ability per piece of apparatus is 100 $Nm^3/(m^2 \cdot hour)$, whereas the conventional methods are 80, 12, and 17 $Nm^3/(m^2 \cdot hour)$. Similarly, regarding the oxygen absorption efficiency: 13.5% against 8.3, 10.5, and 13.0%.

[Table 1]

	Present Invention	Conventional Method A	Conventional Method B	Conventional Method C
Volume of Gas-Liquid Mixture Portion (m^3)	0.006	0.005	0.105	0.124
Air- supplying Ability ($Nm^3/m^2 \cdot min$/apparatus)	100	80	12	17
Oxygen Absorption Efficiency % (Absorbed Amount /Supplied Amount× 100)	13.5	8.3	10.5	13.0

[Application Example 2]

FIG. 13 is a diagram showing an example when a diffused gas aeration apparatus according to the present invention is applied to the diffusion processing of effluent.

Similarly to the example shown in FIG. 12, a diffused gas aeration apparatus 87 according to the present invention is disposed at the bottom of a cylindrical diffusion tank 88; a blower 89 and a pneumatic dispatch line 90 which supply air to the lower part of this diffused gas aeration apparatus 87, an effluent-supplying line 91 which supplies effluent, and a processed water discharging line 92 which discharges processed water that has been cleaned are provided. Further, an exhaust line 93 is provided with a cooling apparatus

or an absorption apparatus which collects volatile substances. In the diffused gas aeration apparatus 87 thus constructed, volatile substances in effluent such as trichloromethane, trihalomethane, ammonia, chlorine and krypton are moved toward the supplied air to be in diffusion processing, and then are collected and cleaned by the cooling apparatus or the absorption apparatus through the exhaust line 93. The cleaned air is released to atmospheric air.

It should be noted that the kind of gas supplied is not limited to the air, and inactive gasses such as nitrogen, helium, argon and carbon monoxide gas can be used accordingly. For example, diffusion processing can be performed with respect to oxygen which remains dissolved in liquid, by using nitrogen gas. Preferably, the supplying rate of gas to be supplied to the inside of the diffused gas aeration apparatus 87 is, when the depth of water inside the diffusion tank 88 is 1 to 3m, in the range of 3600 to 18000 $Nm^3/(m^2 \cdot hour)$, and more preferably in the range of 7200 to 15000 $Nm^3/(m^2 \cdot hour)$.

[Application Example 3]

FIG. 14 is a block diagram showing an embodiment when diffused gas aeration processing according to the present invention is applied to exhaust gas treatment.

A plurality of diffused gas aeration apparatuses 94 are disposed in predetermined positions in a cylindrical reaction tank 95, and below the diffused gas aeration apparatuses 94 is

improves processing capability and results in further space saving. Moreover, since a stagnant part (dead space) of fluid is unlikely to occur in the diffused gas aeration apparatus 94, the accretionary growth of calcium and the like can be prevented, which lowers maintenance costs.

[Application Example 4]

FIG. 15 is a diagram showing an example when a diffused gas aeration apparatus according to the present invention is applied to reaction by means of enzymes or microorganisms.

A diffused gas aeration apparatus 102 is disposed in a predetermined position in a cylindrical bioreactor 103, and a pneumatic dispatch line 104 that supplies gas to the lower part of the diffused gas aeration apparatus 102, a raw liquid supplying line 105 which supplies raw liquid, a reaction product discharging line 106 which discharges reaction products, an exhaust line 107 which discharges gas from the top of the bioreactor 103 and a circulating liquid line 108 which circulates raw liquid from the liquid surface level of the bioreactor 103 to the lower part are provided. Further, in the bioreactor 103, either a catalyst supporting body 109 which supports enzymes or microorganisms, or a biocatalyst exists in liquid. In the diffused gas aeration apparatus 102 thus constructed, gas is supplied from the lower part of the diffused gas aeration apparatus 102 through the pneumatic dispatch line

can be reduced. In addition the apparatus can be used as a gas-liquid reaction apparatus without using biocatalysts. In addition, in a conventional bubble column, the superficial speed of gas is in the range of 0.01 to 0.1m/s.

FIG. 16 is a pattern diagram showing an aeration processing apparatus by means of a conventional panel diffuser method.

As regards a conventional aeration processing apparatus 110, a number of panel diffusers 112 are provided at the bottom surface in an aeration tank 111, and air is supplied to a number of panel diffusers 112 through a blower 113 and a pneumatic dispatch line 114. The panel diffusers 112 are formed of minute perforated bodies, generating minute bubbles. The amount of blowoff air by conventional panel diffusers 112 is 50 to 400L/min. Also, the air-flow resistance is 1000 to 3000Pa.

FIG. 17 is a pattern diagram showing a diffusion processing apparatus by means of a conventional packing method. Regarding a conventional diffusion processing apparatus 115, packing is packed regularly or in irregular manner in a cylindrical diffusion column 116. Gas and raw water pass through packing 117, flowing in opposite directions to each other to be in gas-liquid contact, and diffusion processing is thus executed. In the case of a conventional packing method, the supplying rate of gas is in the range of 10 to 100 $Nm^3/m^2 \cdot hour$.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a pattern diagram showing a first embodiment of

blowoff portion according to the second embodiment of the present invention;

FIG. 11 is a schematic sectional view of a diffused gas aeration apparatus according to a third embodiment of the present invention;

FIG. 12 is a diagram showing an example when a diffused gas aeration apparatus according to the present invention is applied to aeration processing of an activated sludge method;

FIG. 13 is a diagram showing an example when the diffused gas areation apparatus according to the present invention is applied to the diffusion processing of effluent;

FIG. 14 is a diagram showing an example when the diffused gas areation apparatus according to the present invention is applied to an exhaust gas treating apparatus;

FIG. 15 is a diagram showing an example when the diffused gas areation apparatus according to the present invention is applied to biological reaction using enzymes or microorganisms;

FIG. 16 is a pattern diagram showing an aeration processing apparatus of a conventional panel diffuser method; and

FIG. 17 is a pattern diagram showing a diffusion processing apparatus of a conventional packing method.

DESCRIPTION OF REFERENCE NUMERALS

1, 8, 16, 23, 29, 35, 43, 50, 59, 71: PASSAGE TUBE

2, 9, 13, 17, 24, 30, 41,

51, 57, 73, 77: STATIC MIXER

3, 10, 18, 38, 39, 42, 52, 79: SPACE PORTION

<u>Page 32 and page 32/1, page 34, and page 35 of the claims</u>

CLAIMS

1. A diffused gas aeration apparatus comprising: a cylindrical passage tube substantially disposed vertically in which fluid passes in the longitudinal direction and in which a static mixer is provided, and a gas blowoff portion on the lower end side of said passage tube, which gushes and supplies gas to the inside of said passage tube through a pneumatic dispatch line and in which a spray nozzle is provided; wherein gas is supplied to said gas blowoff portion, liquid is introduced into said passage tube from the lower side of said passage tube, said gas and liquid flow upward in a parallel direction in said passage tube, and the gas and liquid come in gas-liquid contact inside said passage tube to be discharged from the upper end side of said passage tube into liquid.

2. A diffused gas aeration apparatus comprising: <u>a cylindrical passage tube substantially disposed vertically in which fluid passes in the longitudinal direction and in which a first static mixer is provided,</u> and a gas blowoff portion on the lower end side of said passage tube, which gushes and supplies gas to the inside of said passage tube through a pneumatic dispatch line and <u>in which a second static mixer is provided</u>; wherein gas is supplied to said gas blowoff portion, liquid is

introduced into said passage tube from the lower side of said passage tube, said gas and liquid flow upward in a parallel direction in said

7. A diffused gas aeration apparatus according to any one of claims 1 to 5, wherein the rising speed of gas in said passage tube is in the range of 0.5 to 5m/s.

8. A diffused gas aeration apparatus according to any one of claims 3 to 7, wherein the twist angle (<u>turning angle</u>) of blades is 15°, 30°, 45°, 60°, 90°, 180° or 270°.

9. A diffused gas aeration apparatus according to any one of claims 1 to 3, wherein the supplying rate of the amount of air which flows from the lower side to the upper side inside said diffused gas aeration apparatus is, when the water depth inside an aeration tank is 2 to 6m, in the range of 1800 to 21000 <u>$Nm^3 \cdot /(m^2 \cdot hour)$</u>.

10. A diffused gas aeration apparatus according to any one of claims 1 to 3, wherein the supplying rate of the amount of air which flows from the lower side to the upper side inside said diffused gas aeration apparatus is, when the water depth inside an aeration tank is 2 to 6m, in the range of 3600 to 12000 <u>$Nm^3 \cdot /(m^2 \cdot hour)$</u>.

11. A diffused gas aeration apparatus according to any one of claims 1 to 3, wherein the supplying rate of gas which flows from the lower side to the upper side inside said diffused gas

aeration apparatus is, when the water depth inside a diffusion tank is 1 to 3m, in the range of 3600 to 18000 $Nm^3 \cdot /(m^2 \cdot hour)$.

12. A diffused gas aeration apparatus according to any one of claims 1 to 3, wherein the supplying rate of gas in a bioreactor, which flows from the lower side to the upper side inside said diffused gas aeration apparatus is in the range of 0.1 to 5m/s.